Kwapi: A Unified Monitoring Framework for Energy Consumption and Network Traffic
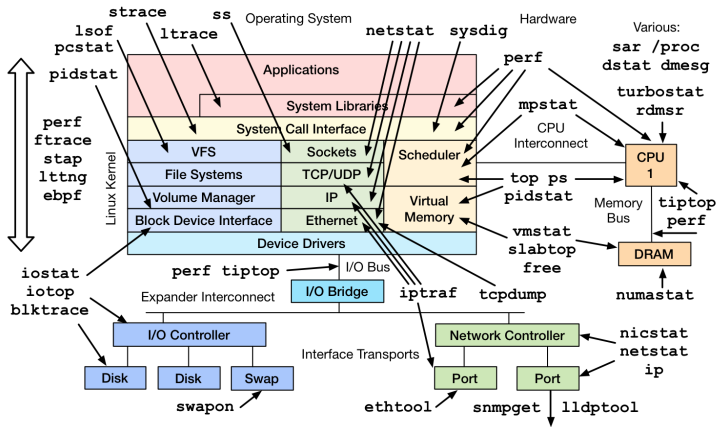
Florentin Clouet, Simon Delamare, Jean-Patrick Gelas, Laurent Lefèvre,
Lucas Nussbaum, Clément Parisot, Laurent Pouilloux, François Rossigneux

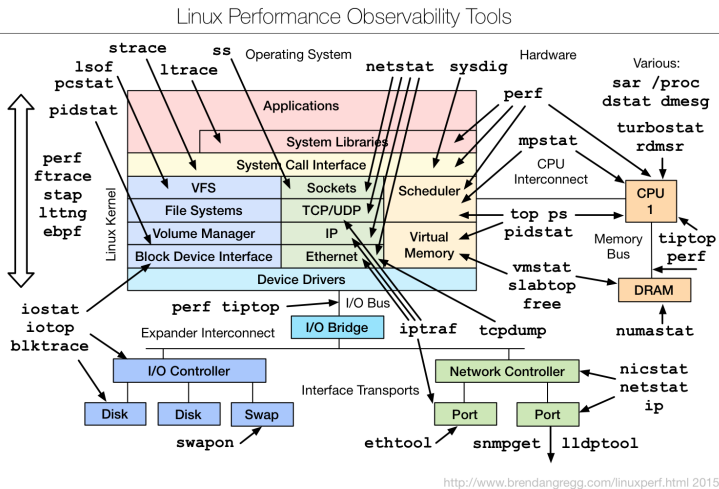Short version of a TRIDENTCOM'2015 talk
Paper + slides: `http://deb.li/kwapi`

OTS monitoring and measurement tools

Linux Performance Observability Tools

http://www.brendangregg.com/linuxperf.html 2015

OTS monitoring and measurement tools

Linux Performance Observability Tools

http://www.brendangregg.com/linuxperf.html 2015

Many tools available, but:

- ▶ Need to be configured by the experimenters
- ▶ Often intrusive (running on users' nodes, non-negligible overhead)

Monitoring solutions for system administration

- ▶ MRTG, Munin, Ganglia, Nagios, etc.

- ▶ Main focus: monitor long term variations, tendencies

- ▶ Designed for low resolution (5 mins) ⤳ unsuitable for experimenters

This talk: Kwapi

- **Monitoring and measurement framework for the Grid'5000 testbed**

- Initially designed as a power consumption measurement framework for OpenStack – then adapted to Grid'5000's needs and extended

- For energy consumption and network traffic

- Measurements taken at the infrastructure level (SNMP on network equipment, power distribution units, etc.)

- High frequency (aiming at 1 measurement per second)

Multi-metrics support: energy and networking
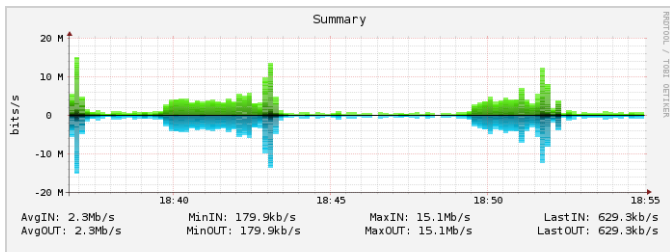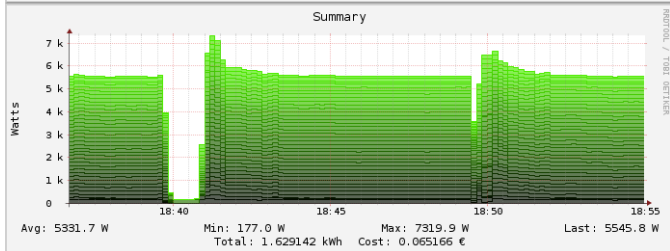

- ▶ 18:39:28 – machines are turned off
- ▶ 18:40:28 – machines are turned on again and generate network traffic as they boot via PXE
- ▶ 18:49:28 – machines reservation is terminated, causing a reboot to the default system

Data access and storage

- ▶ Metrics collected by Kwapi are stored:
  - ♦ In RRD files (typical for monitoring systems)
  - ♦ In HDF5 files, for long-term loss-less archival
    - ★ One year of Grid'5000 monitoring = 720 GB

- ▶ Visualization via a web interface (selection by nodes or job numbers)
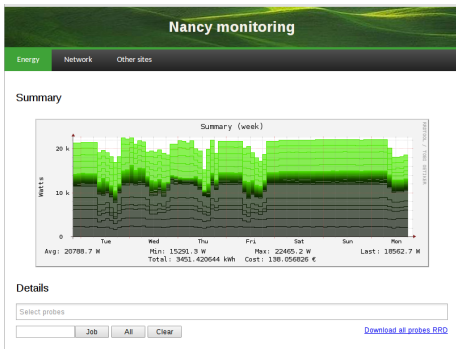
- ▶ Data also exported via the Grid'5000 REST API
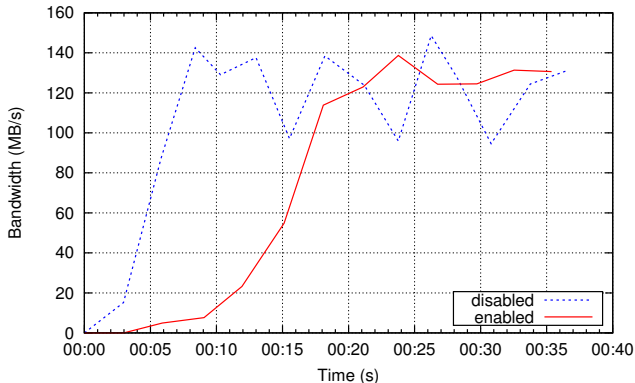
Some example use cases

Visualizing TCP congestion control

- ► Linux's implementation of TCP CUBIC includes the Hystart heuristic
    - ♦ Detects congestion by measuring RTT
   - ♦ Broken until Linux 2.6.32

- ► Not as accurate as `nuttcp` or `iperf` but:
    - ♦ Measurements are completely passive from the experiment POV
    - ♦ No instrumentation required on nodes

Extracting power consumption trends

- ► Grid'5000 distinguishes between two time periods:
  - ♦ daytime – shared usage to prepare experiments
  - ♦ nights and week-ends – large scale experiments

- ► As a result, there are often free resources during the day

- ► Also, nodes are automatically shut down when not used

- ► **Does this reflect in power consumption as seen by Kwapi?**

Extracting power consumption trends

- ▶ Grid'5000 distinguishes between two time periods:
  - ♦ daytime – shared usage to prepare experiments
  - ♦ nights and week-ends – large scale experiments
- ▶ As a result, there are often free resources during the day
- ▶ Also, nodes are automatically shut down when not used
- ▶ **Does this reflect in power consumption as seen by Kwapi?**
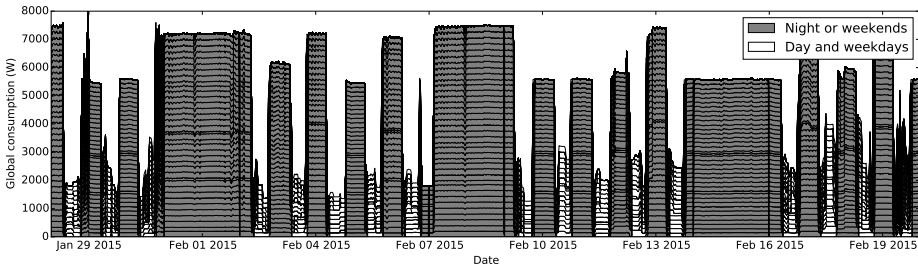
Evaluating energy-aware schedulers

- ▶ DIET: energy-aware distributed computing middleware
- ▶ Scheduler starts computing nodes based on energy cost
- ▶ Kwapi provides a feedback loop

Comparaison between candidate nodes and energy consumption through context events
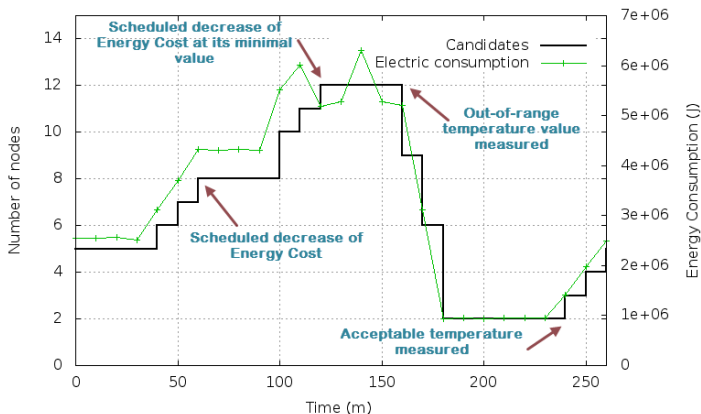
Conclusions

▶ **Kwapi: the integrated monitoring solution of the Grid'5000 testbed**

▶ Already widely used on Grid'5000

▶ Available as free software

▶ Try it on your testbed, or on Grid'5000 (Open Access program)

▶ Future work (collaboration opportunities?)
  ♦ Additional metrics: reactive power, network errors, Infiniband, storage systems, server room temperature, etc.
  ♦ Integrate with other monitoring solutions (sFlow/NetFlow, collectd)
  ♦ OML support: expose measurement points